Sedimentary deposits from the 17 July 1998 Papua New Guinea tsunami

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The 17 July 1998 Papua New Guinea (PNG) tsunami was devastating to residents of coastal villages located near the shoreline. After uprooting trees and destroying homes, the retreating tsunami left an extensive sedimentary deposit across the coastal plain easily identifiable as sand overlying a dark soil. The study of these deposits can aid in determining characteristics (e.g., wave height, flow strength, number of waves) of the 17 July tsunami. Wave characteristics such as these may be useful in differentiating among a possible earthquake or submarine landslide source of the tsunami (Geist, 2000; Tappin *et al.*, 1999). In addition, detailed study of the sedimentology of the PNG tsunami deposits will be useful for improving models of tsunami sedimentation for use in interpreting paleo-tsunami deposits. A better understanding of these deposits will help geologists interpret tsunami deposits in the geologic record, thus improving evaluation of tsunami hazards in general.

Field surveys of sediment deposits and erosion from the 1998 Papua New Guinea tsunami were made within 3 months of tsunami landfall as part of the second International Tsunami Survey Team. Measurements were made of land elevation, tsunami flow depth, flow direction, and tsunami deposit thickness and character along several transects in the affected area (Fig. 1). Numerous small pits were dug along these transects to examine the tsunami deposit thickness and to take samples for detailed grain-size analysis. Tsunami deposits were common and were identified as gray-colored sand typically overlying a brown, rooted soil (Fig. 2). Tsunami sedimentation was discontinuous and not only reflected the flow during the tsunami, but also the grain size of the sediment source. Sand sheets ranged in thickness from 1 to 16 cm and extended up to 700 m inland. Deposits were found at locations spanning more than 30 km of coast in the region where the tsunami was largest (Waipo to Sissano Village).

A transect at the Arop Community School (Fig. 1), several hundred meters from the village of Arop, which was destroyed by the tsunami, demonstrates some of the sedimentological trends found (Fig. 3). Evidence described by the first International Tsunami Survey Team suggested the tsunami reached a height of approximately 10 m at this site (Kawata *et*

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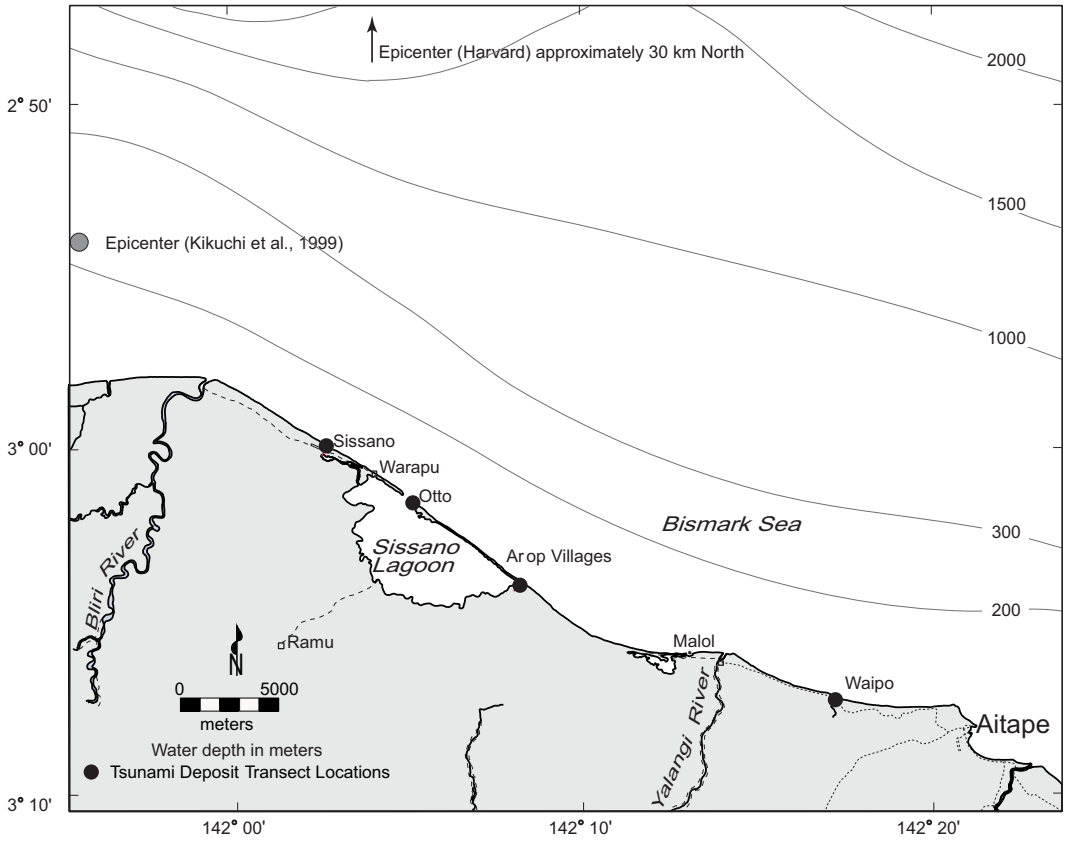

Figure 1: Location map of Sissano Lagoon along the coast of Papua New Guinea and the transects where tsunami deposits were studied. Also included are the approximate locations of the epicenter as determined by Kikuchi *et al.* (1999) and Harvard CMT, and the submarine failure as determined by Tappin *et al.* (1999).

al., 1999). The topography along this transect is characteristic of much of the PNG coast near the Sissano lagoon. The beach is narrow and within a few tens of meters of the shoreline the elevation reaches a local maximum of approximately 2.5 m above sea level. Moving landward, the elevation drops down to about 0.5 m above sea level. The profile remains nearly flat, gradually rising to 2 m above sea level 700 m from the shoreline.

Along the Arop transect, a zone about 75 m wide near the ocean eroded as evidenced by exposed tree roots. In this zone, no new sand was deposited by the tsunami. Some sand deposited further inland by the tsunami came from the eroded beach, but at least some of the sand deposited by the tsunami further inland is believed to have come from offshore of the beach as numerous sand dollars were found near the surface of the deposit. The deposit thickness reached a maximum along this transect of about 12 cm, but was uniformly 6–8 cm thick for over 400 m in the cross shore direction. The deposit thinned from 500 m inland to 700 m inland, extending almost as far inland as the furthest evidence for inundation.

The mean grain size decreased gradually with distance inland from about 2–2.5 phi close to the shoreline to 3.5–4 phi at the landward extent of the

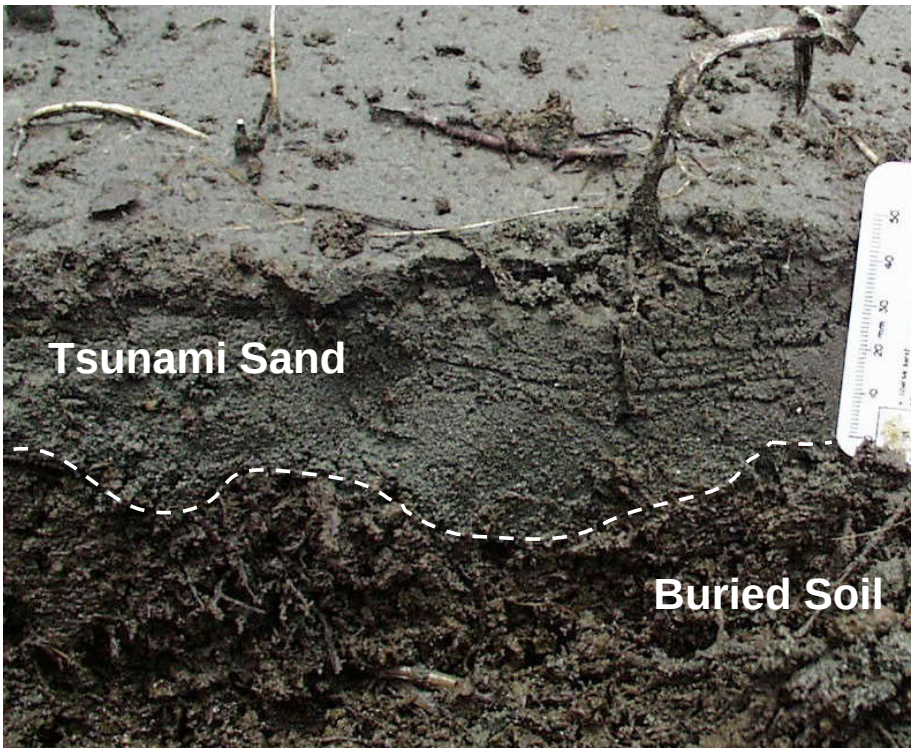

Figure 2: Photograph of tsunami sand overlying a buried soil.

deposit. The tsunami was capable of carrying larger particles; however, none were present at this location. As with deposit thickness, the grain size was fairly uniform across the transect from 100 m to 500 m inland. The sediment skewness changed from negative to positive and increased with distance inland. This change suggests that the coarser sand was deposited closer to shore, whereas the finer material was uniformly deposited across the transect.

The 17 July 1998 tsunami left extensive sedimentary deposits on the low-lying coastal plain of PNG. This study has documented how thickness and grain-size distribution of the deposit varied with distance inland from the ocean. Further research will include comparing the observed tsunami deposits with models of sediment transport during the tsunami to learn more about the tsunami's characteristics. In particular, this modeling will give us information on flow velocities and wave heights that may be useful in discriminating among various generation mechanisms.

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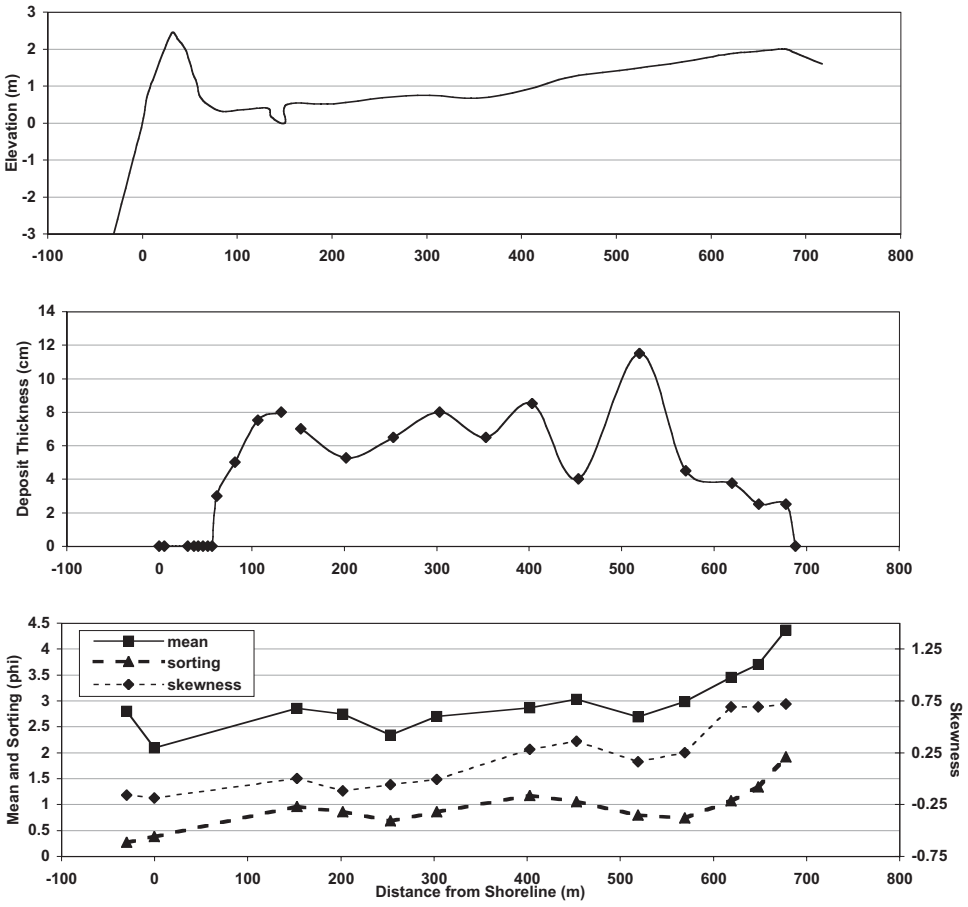

Figure 3: Transect near the Arop School showing the elevation of the coastal plain (upper panel), the tsunami deposit thickness (middle panel), and the tsunami deposit mean sediment size, sorting, and skewness (lower panel) plotted against distance from the shoreline.

1. References

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